Incorporating "The Illuminating Engineer."

Light and Lighting

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Principal Contents:

Alleviating the Black-Out

THE Prime Minister's recent address offered hope of some alleviation of the black-out during the coming winter. A committee now sitting is exploring possibilities and is receiving expert assistance from members of the Illuminating Engineering Society, who were amongst those responsible for the framing of the present specification.

The amount of light permissible is a matter of policy. Once an understanding is reached how much light can safely be allowed, it is the task of the lighting expert to devise means of ensuring that this limit is not exceeded and the best possible value is obtained from it. This task has been performed with signal success. The method of securing uniformity in the provision of the specified 0.0002 foot-candles has worked remarkably well. For many years the anomalies and variations in the degree of illumination provided in different streets and by different authorities have been the subject of comment. Now, for the first time, both for gas and electric lighting, there is uniformity of results throughout the land.

There may be a lesson for the future here, a hint that, when full lighting is restored, we should continue to adhere to a common standard. For the moment, however, we are concerned with our measure of twilight illumination. Perhaps the limit imposed may be raised a little, at least in cities where tall buildings have a shuttering effect, in which case the installation of the standard units at more frequent intervals would be a welcome gain. Perhaps, also, at important traffic junctions, it may be possible to reinforce the present permanent system by special illumination, extinguishable on demand, and to allow greater freedom for the display of light in show-windows and in signs of mild luminosity.

Whatever shape the alleviation may take we hope that it will be devised on scientific lines, so as to supplement existing arrangements — it would be a thousand pities if in granting concessions the sound basis of the present system were impaired.

I.E.S. Opening Meetings

The attention of readers is drawn to the following programme of meetings of the Illuminating Engineering Society provisionally arranged to take place in London in the autumn:—

Tuesday. Oct. 8.—Opening Meeting. Address by Professor J. T. MacGregor-Morris (President), entitled "The Arc as a Standard of Light." (*To be held at the Royal Institution, 21, Albemarle-street, London, W.1.*)

Tuesday, Oct. 22.—A Paper by Mr. H. C. Weston, entitled "War-Time Industrial Lighting." (*To be held at the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.*)

Tuesday. Dec. 10.—Demonstrations of the Effect of Contrast in Illuminating Engineering. (*To be held at the E.L.M.A. Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.*)

It is, of course, a privilege for the Society to be allowed to hold a meeting in the famous Lecture Theatre of the Royal Institution.

Further meetings are in prospect in 1941, when Dr. W. D. Wright is to read a paper on "Vision In Very Weak Light" (January 14), and Mr. J. G. Holmes on the "Recognition of Coloured Light Sources" (February 11).

A very useful series of meetings has also been arranged by the various Local Centres, particulars of which are to be found in the TRANSACTIONS (No. 8, September, 1940, p. 122). It is certainly encouraging to find the programme almost reverting to pre-war volume. Whilst, at the moment of writing, circumstances are certainly becoming difficult in London we hope that it will be found possible to persevere with this programme.

Physical Society Colour Group

The number of industries and societies interested in colour is very considerable, and there is a great need for consultation between experts. The Physical Society is therefore forming a group, composed of physicists, chemists, and industrialists, to study such matters as standardisation, specification, and nomenclature of colour. It is hoped to hold the first meeting about the middle of October, when there will be a discussion on "Colour Tolerance." In the meantime, societies concerned have been approached. We notice that the chairman is Dr. W. D. Wright and that the committee includes Mr. J. Guild and Mr. J. G. Holmes—all well-known to members of the Illuminating Engineering Society.

Anyone desiring further information in regard to the Physical Society Colour Group is invited to apply to the honorary secretary, Mr. H. D. Murray, 1, Lowther-gardens, Exhibition-road, London, S.W.7.

Illuminating Engineering Society U.S.A.

Thirty-Fourth Annual Convention

The Illuminating Engineering Society in the United States is this year returning to the eastern seaboard for its annual convention, which is to be held at Spring Lake, New Jersey, during September 9-12. The programme of papers includes contributions on Predictions of Lighting Performances of Plastic Mould Designs by the aid of models, Fittings for Fluorescent Lamps and Photometric Problems Involved, Radiation from H.P. Mercury Arcs, Ultraviolet Excitation of Fluorescent Compounds, Bactericidal U.V. Radiation, Use of Radiant Energy for Heat, Radiant Temperatures from Lighting Systems with Comfort Correlations, Schoolroom Lighting, and Windowless Industrial Plants. A session, planned jointly with the Inter-Society Colour Council, is also to be devoted to colour problems. At the conclusion of the convention members will have an opportunity of visiting the World's Fair at New York. As usual, there are agreeable social events, and the advice in the official programme on "What to Wear" (beach attire essential!) is indicative of pleasant times which will inevitably excite some envy amongst those living under less tranquil conditions.

Responsibility for Lighting Streets

An important legal point has recently been decided. A claim made against the St. Marylebone Borough Council arose through an accident on the first night of the Black-out Regulations when a taxicab came into collision with an unlighted bollard. On July 30 a decision was given in favour of the Council, thus reversing a previous one. It was successfully contended that in the present circumstances there was no obligation to light the bollard. In view of this case it is interesting to observe that on August 19 a decision was given against the Stepney Borough Council in respect of a claim for injuries experienced owing to collision with a sandbin on the pavement. "The fact that a corporation is absolved from its duty of lighting the streets," it was remarked, "does not absolve it from the duty of seeing that pedestrians are not subjected to accident by any carelessness on the part of the corporation." It was further suggested that a splash of whitewash on the sandbin might have prevented the accident—though in a technical sense it would seem that such a splash would be of no avail unless some light, either natural or artificial, was available.

New Lighting for a Surgical Instrument Forge

At the Bethnal Green factory of Messrs. Allen and Hanbury surgical instruments of all kinds, from forceps to operating tables, are produced. Most of the processes require highly skilled labour. The manufacture of high-grade surgical instruments does not lend itself to mechanical mass production, and the clumsy hammer wielded by the careful hand still holds sway. The work of the forgers by whom the conversion of stainless steel bars into forceps or scalpels is effected is of interest in another respect. They judge the temperature of the bars by the colour or redness after heating. Now, the range of ideal forging temperatures of stainless steel is a narrow one. Any abrupt variations in the extraneous light, such as those due to changes from bright sunshine to overcast skies, which affect the judgment are therefore apt to prove disconcerting. The new tubular fluorescent lamp, yielding a steady diffused light, very near to daylight in colour, has solved the problem. The illustration shows one of these lamps installed by the G.E.C. over one anvil and block. Four other fittings of the same type will be eventually fixed over the other anvils.

A 5 ft. Osira fluorescent lamp installed at Messrs. Allen and Hanbury's, Ltd.

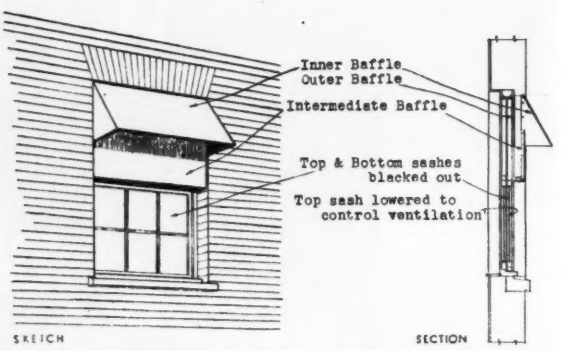


Fig. 2. Ventilator Light-Trap for sash window, wholly or largely blacked out.

Ventilation for Buildings in Conditions of Black-out

British Standard Specification BS/ARP 31. Issued July, 1940. Prepared under the aegis of a Joint Committee of the Ministry of Home Security and the Illuminating Engineering Society.

In our last issue (August, 1940, p. 126) we referred to the above specification. We now reproduce one or two illustrations therefrom showing alternative forms of light traps. The fundamental principles are explained in Fig. 1. An important requirement is that the whole of interior of the ventilator light trap should have a surface equivalent to that given by a coating of matt black paint. It is expedient that no light should fall directly from a source on to any surface within the trap visible from outside the building. The problem of obscuration is greatly simplified when artificial light sources can be so screened that they do not throw light directly on to the light trap.

The use of baffles in the design of ventilator light traps restricts the flow of air to some extent. As a general rule it may be assumed that an effective light trap will reduce the ventilating efficiency of an opening by at least 50 per cent., and this should be taken into consideration in allotting ventilating area. In all places where noxious fumes are liable to collect, supplementary forced draught ventilation may be necessary.

Figs. 2, 3, and 4 show a few out of many possible ways of meeting this problem.

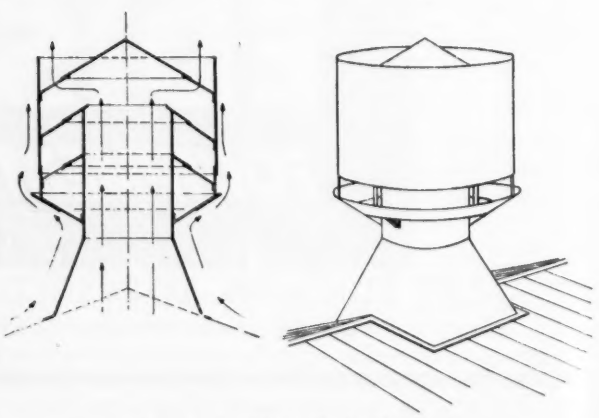


Fig. 4. Roof Ridge Outlet Ventilator.

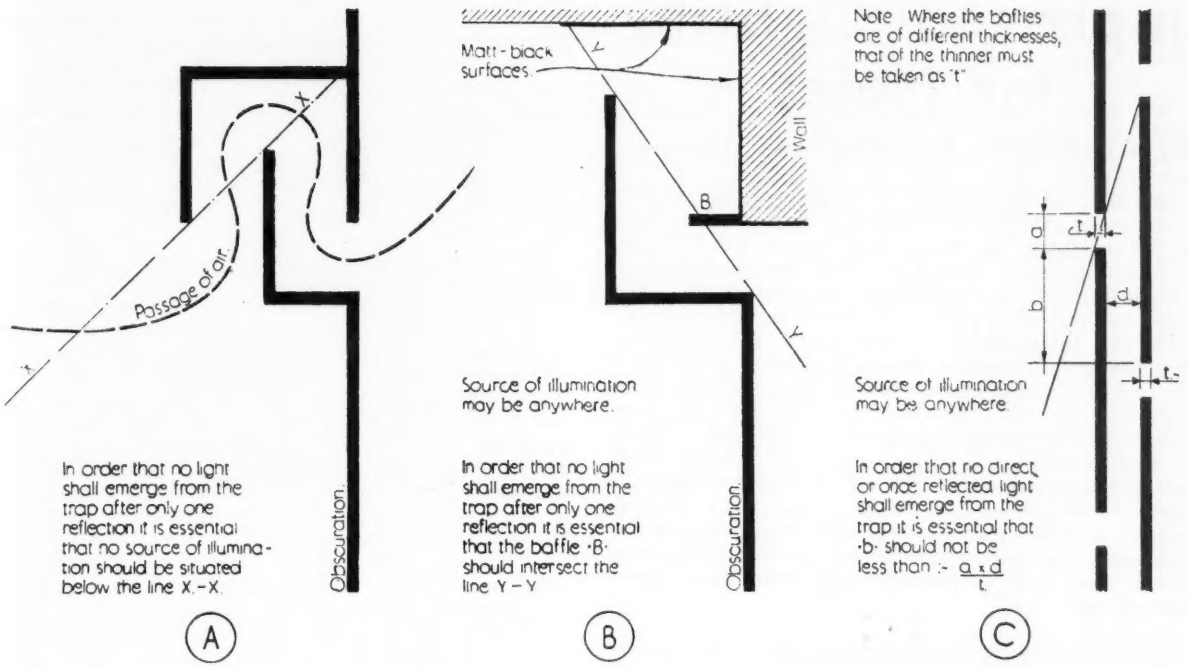


Fig 1. Diagram illustrating the principle of Light-Traps.

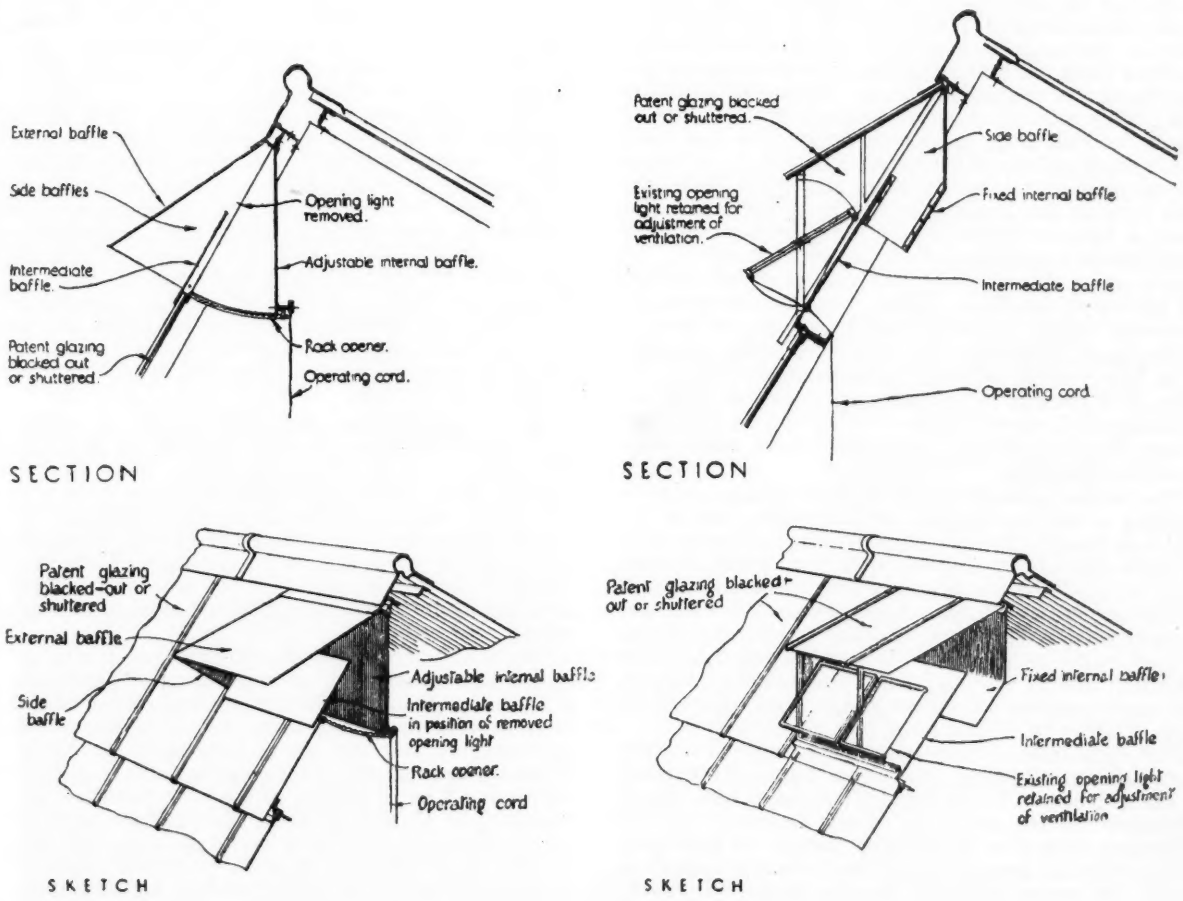


Fig. 3. Light-Trap Roof Ventilators.

Improved Lighting for Mines

By H. K. BOURNE, B.Sc. (B.T.H. Research Laboratory).

PREFACE.—A contribution on "Lighting in Mines—The Development and Use of the Mercury Vapour Compressed Air Electric Lamp," by Messrs. E. A. Watson, O.B.E., M.Sc., M.I.E.E., L. J. Davies, M.A., B.Sc., H. K. Bourne, B.Sc., and T. David-Jones, M.Sc., Ph.D., F.G.S., was read to the South Wales Institute of Engineers at Cardiff on December 8, 1938, and was published in Volume LIV., No. 6, of the "Proceedings of the South Wales Institute of Engineers." This new form of lamp is now familiar to colliery engineers of this country, but is possibly less well known to those concerned with illuminating engineering generally. With the kind permission of the co-authors, this paper, which deals principally with the light source itself and which is largely an abstract from the longer and more detailed paper mentioned above, has therefore been prepared for illuminating engineers, who will doubtless find applications for this new form of portable lamp other than those underground.

There has long been a demand for an improvement in the underground lighting of mines, particularly in coal mines. An increase in the illumination in a coal mine gives many benefits to both the management and the workers alike. Improvement in working conditions leads to a higher output and fewer accidents. For humanitarian and for economic reasons an increase in illumination in coal mines, to a value considerably above the value in use in the majority of mines at the present time, is well justified.

The problem of underground lighting in a coal mine may be divided into two sections. The first of these is concerned with the lighting of the main roadways in the mine, leading away sometimes for a mile or more from the bottom of the pit shaft towards the coal faces where the coal is cut. Such roadways are often wide enough to accommodate several lines of tracks for coal waggons which convey the coal from the loading points to the shaft where it is raised to the surface. The coal is often conveyed from the coal face to the loading points by a belt conveyor along a narrow tunnel which is not wide enough to accommodate rail tracks for the coal trucks. At points along the conveyor the coal is sorted so that all pieces of shale or other useless material are removed before the coal is taken to the surface.

The main roadways in a mine are often supplied with low voltage electric mains, not exceeding 110 volts, and flameproof fittings containing 60 watt incandescent filament lamps are spaced at intervals along the roof. These units provide a reasonably good illumination.

The second part of the problem is concerned with lighting at the loading and sorting points and at the coal face itself. The problem involved in these cases is more difficult of solution and is of great importance, as it is at the coal face where the working conditions are so severe, and consequently it is essential to have good illumination in order to help the operators as much as possible. It is proposed to devote attention mainly to this part of the problem, though the same method of lighting has been adopted in each of these three positions in a coal mine.

The regulations which have been imposed on the use of electric lighting at the coal face are stringent in the extreme. These regulations have been made necessary by the presence of gas in many of our collieries, with the consequent danger of explosion in the event of any electrical fault causing a spark to occur. In many collieries the use of electric mains at the coal face is forbidden. Consequently it has been necessary to devise forms of illumination which are not dependent for their operation upon electric mains. A pneumatic electric lamp, operating from the compressed air supply, known as the M.L. lamp, has been developed for some years. This lamp has been approved by the Ministry of Mines and is completely safe to use in any part of a coal mine, even in an explosive atmosphere. At present two makes of this type of lamp (the M.L. and the Wolf Bistock lamp) are in use in British collieries. Over 2,000 of the lamps are in operation in coal mines throughout the country.

The M.L. lamp consists of a number of components housed in a metal casing. An air turbine, operating through a reducing valve which automatically reduces the air pressure to approximately 40 lb. per sq. inch whatever the pressure of the supply may be, drives a generator, the rotor of which is mounted on the spindle of the turbine. The generator rotor carries a six pole permanent magnet. The generator windings are on the stator. The possibility of sparking is, therefore, excluded, as there are no rubbing contacts. The lamp bulb is mounted in a holder on top of the generator, and leads connect this holder directly to the terminals of the generator. A heavy frosted cover glass on top of the unit protects the lamp and diffuses the light in order to prevent glare. An ingenious safety device is incorporated which short circuits the generator in the event of failure of the air supply or breakage of the cover glass around the lamp. This consists of a diaphragm carrying a contact which normally presses against a fixed contact, these two contacts being connected across the generator terminals. When the lamp is operating the exhaust air from the turbine passes into the cover glass around the lamp before exhausting through a number of small holes which create a back pressure. An excess of pressure is produced on the diaphragm, so causing the contacts to remain open. The lamp will thus operate until the pressure falls when the diaphragm closes the contacts which short circuit the generator, thus preventing a voltage which might cause an arc from appearing across its terminals. This will occur if the air supply fails or if the cover glass is broken.

These units have been made to take 36 or 60 watt incandescent filament lamp bulbs, and they have proved very satisfactory in service. Their introduction marked a great advance over the handlamps which were the only source of illumination used hitherto at the coal face. They have demonstrated the advantages to be gained by using higher illuminations at the coal face, with the result that a demand arose for a further increase in illumination. This has now been accomplished by using the new high pressure mercury vapour electric discharge lamps of high efficiency in place of the incandescent lamps in these units.

After considerable research work, a mercury vapour lamp suitable for operating in an M.L. lamp has been developed, and now the M.L. Mercury Vapour Mine Lamp represents the latest form of the pneumatic electric lamp for colliery lighting. The development of this lamp has brought about improvements in the underground illumination of coal mines similar to those obtained in street and interior industrial lighting by using the modern electric discharge lamps.

The actual lamp bulb used in the pneumatic generator for mines has to meet some particularly arduous conditions. It must be very robust in order to withstand the rough usage which it may receive underground and the severe conditions of vibration when the unit is suspended on a coal cutter or similar machine. High efficiency of the unit, with a view to economy in air consumption, is another important point. Finally, the lamp must have a long life, which should not be affected appreciably by incorrect operating conditions. The high efficiency mercury vapour lamp, which has no fragile filament, meets these requirements very satisfactorily. A lamp of this type,

Fig. 1.

which will fit into the generator unit previously designed for the filament lamps, has now been produced. The characteristic curve of the generator has been altered to suit the operating characteristics of the mercury vapour lamp.

The new lamp is fundamentally similar to the M.L. lamp already described. It has been approved by the Mines Department for use at any point in coal mines in this country. A photograph of the complete lamp is shown in Fig. 1. In this photograph a clear outer glass is shown so that the lamp itself may be seen. In practice it is usual to employ a frosted outer glass in order to reduce the glare from the source to a value which does not cause any discomfort to the user. Fig. 2 gives sectional diagrams of the lamp showing the constructional details.

The light source used in the new pneumatic electric lamp is a 40-watt high-pressure mercury vapour lamp. This lamp has required a number of special features in its design owing to its low wattage and to the fact that the lamp has to operate from the special generator. In order to make a low-wattage lamp of high efficiency it is necessary to use quartz instead of glass for the arc tube. The reasons for this may

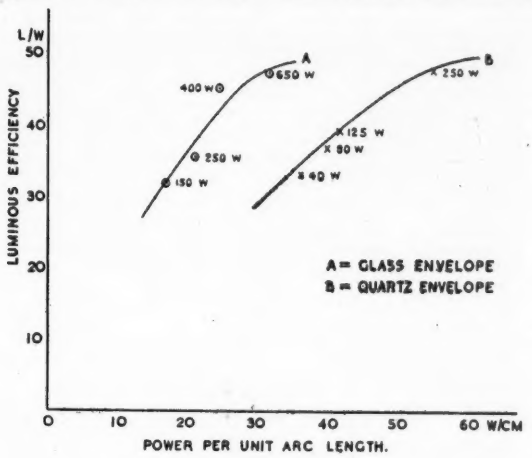


Fig. 3.

be explained by referring to the curves given in Fig. 3. In general the efficiency of a mercury vapour lamp increases as the power per unit length in the arc is increased. Curve A shows how the efficiency of the mercury vapour lamps falls as the wattage is reduced. Curve B shows a similar curve for lamps made of quartz instead of hard glass. In this case the wattage per unit length is greater as the quartz will withstand a higher temperature than the glass,

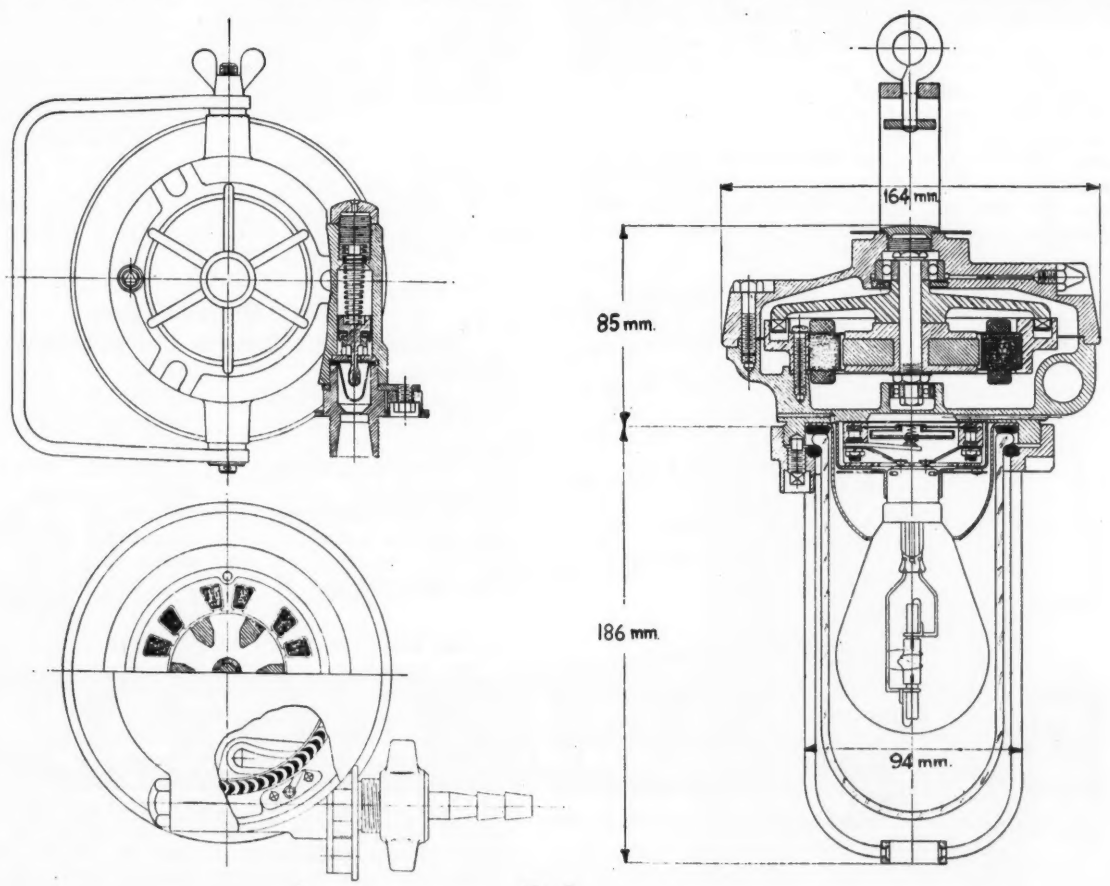


Fig. 2.

and it can be seen that in a quartz lamp a reasonably high efficiency at a low wattage may be obtained.

The arc length of the 40-watt lamp is 11 mm. The arc operates within a tube of quartz 16 mm. long and 3.5 mm. inside diameter between two electrodes coated with an electron emitting material. The arc tube contains 2.5 milligrams of mercury, all of which is evaporated when the lamp is operating. The lamp contains a filling of argon at 4 cm. pressure (of mercury) to provide the medium for striking the arc initially. An auxiliary electrode for striking the lamp is used, consisting of a few turns of wire wrapped around the exterior of the arc tube near to one electrode and connected electrically to the electrode at the other end of the lamp. The capacity current flowing from this wire through the quartz causes the initial ionisation necessary for striking the lamp. This external starting wire is used in place of the more usual internal electrode used on larger lamps. It is possible to use the external wire in this lamp owing to the high frequency of the supply from the generator, of 400 to 500 cycles per second. The external starting wire simplifies the construction considerably. The provision of an internal starting electrode in such a small lamp would be difficult and would cause some obscuration of the light output.

The characteristics of the generator used for operating this lamp are such that the lamp voltage drop should be approximately 100 volts in order to operate on an efficient part of the generator characteristic curve. The lamp voltage drop is determined by the quantity of mercury in the lamp, and when the lamp is operating at its normal wattage all this mercury has evaporated and the mercury vapour in the lamp is in a superheated condition. The lamps were found to be unstable if the arc voltage drop exceeded 105 volts and if they were subjected to a severe mechanical shock, such as is often experienced in service in a coal mine. Lamps were tested in the laboratory on a machine which subjected them to mechanical shocks, and the effect of this on the arc voltage was observed by means of a cathode-ray oscillograph. The actual quantity of mercury in these lamps is very small, and so manufacturing considerations require as large a tolerance in voltage drop as possible. The lower limit of voltage drop is 80 volts. Below this value the lamp would operate on an inefficient part of the generator characteristic and also the lamp wattage would be low. This small tolerance in lamp voltage drop necessitates very careful control of the quantity of mercury in these lamps.

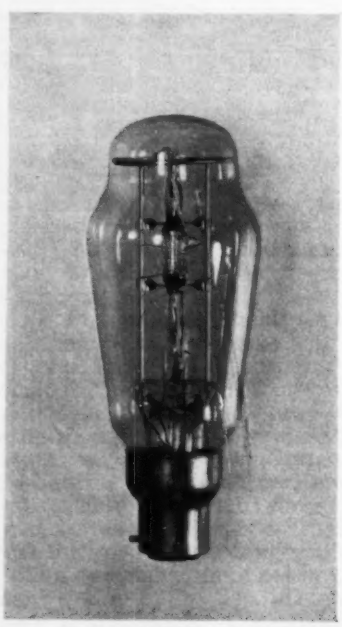


Fig. 4.

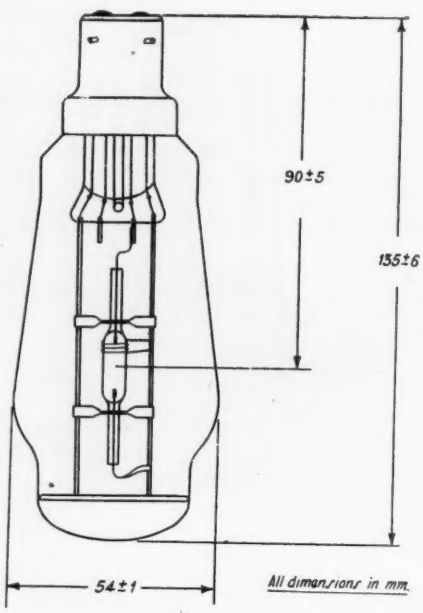


Fig. 5. 40 watt mercury vapour discharge lamp for use with miner's lamp generator.

The inner lamp is mounted in an outer glass jacket filled with about 1/2 atmosphere of a mixture of argon and nitrogen. The outer jacket serves as a heat conservator and also protects the quartz from deterioration which would otherwise occur if the quartz was operated at a high temperature in air.

A very strong form of mounting for the lamp has been adopted in order that it may withstand the severe conditions of service in mines. A number of laboratory tests were carried out on various forms of mounting, and it was finally decided to employ a dome shaped bulb similar to that used in a radio valve. A very strong form of mounting in this type of bulb has been developed, and practical experience with the lamps in service underground show that the latest form of mounting is sufficiently robust. A photograph of a 40-watt mercury vapour lamp for use in the mine lamp is shown in Fig. 4, and the dimensions are given in Fig. 5. The chief technical data on the lamp are given in Table I. below.

TABLE I.

40-Watt "Mercra" Lamp.

Electrical and General Characteristics.

Lamp Watts	40
Lamp Starting Current ...	0.7 to 0.8 amp.
Lamp Running Current ...	0.5 amp. approx.
Arc Voltage Drop	80 to 105.
Initial Luminous Efficiency	35 lumens/watt.
Overall Length	135 mm.
Outside Diameter	54 mm.
Light Centre Length ...	85 mm.
Cap	3-pin B.C.
Outer Bulb Filling ...	1/2 atmos. of nitrogen argon mixture.

It has been necessary to employ a special design for the generator in order to operate the mercury vapour lamp. The generator is designed so that the series reactance required for stabilising the arc is incorporated in the generator winding itself, and the short-circuit current from the generator is sufficient to enable the lamp to run up to full brilliancy as quickly as possible. The open circuit voltage is high enough to strike the lamp, and the generator speed under normal conditions is that at which the air turbine has its maximum output and efficiency. Characteristic curves of the generator are shown in

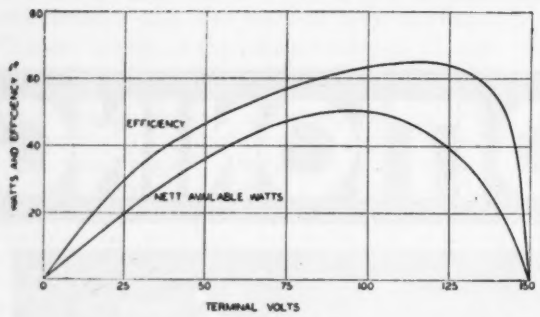


Fig. 6.

Fig. 6 and Fig. 7, and the leading technical data are given in Table II.

TABLE II.

The M.L. Mercury Vapour Mine Lamp Generator. General Technical Data.

Air consumption, approx. 5.5 cu.ft. of free air per minute or 8.5 M^3 per hour.

Minimum pressure permissible in pipe line, 40 lb. per sq. inch or 2.5 atmospheres.

Maximum pressure permissible in pipe line, 100 lb. per sq. inch or 7 atmospheres.
(Special reducing valves and nozzles can be provided for other pressures if required.)

Dimensions of lamp as Fig. 2.

Weight of lamp, 13¾ lb. or 6.24 kg.

The high operating frequency of 400 to 500 cycles per second is advantageous in that it simplifies the problem of designing the generator so that it has sufficient internal reactance to stabilise the lamp. It also enables the construction of the mercury vapour lamp to be simplified, as an external starting wire may be used. The stroboscopic effect sometimes observed with electric discharge lamps is not noticeable with this high frequency supply. Oscillograms of the lamp voltage and current on supply frequencies of 50 and 400 cycles per second are given in Fig. 8. These show that the period in the cycle during which the current is nearly zero is reduced at the higher frequency. This is an advantage as the stability of the lamp is improved. The cyclic variation of the light output with the two different frequencies is shown in Fig. 9. The reduction in flicker at the higher frequency is apparent.

Two other important characteristics, common to discharge lamps, remain to be discussed. After they have been switched on about three minutes is needed before these lamps reach full brilliancy. Again, if the air supply fails when the lamp is running, it will be extinguished and will not restrike again for several minutes. This delay, the chief disadvantage of the mercury vapour lamp, is not a very serious drawback in practice. In the darkness of a coal mine the lamp already appears to be giving a useful

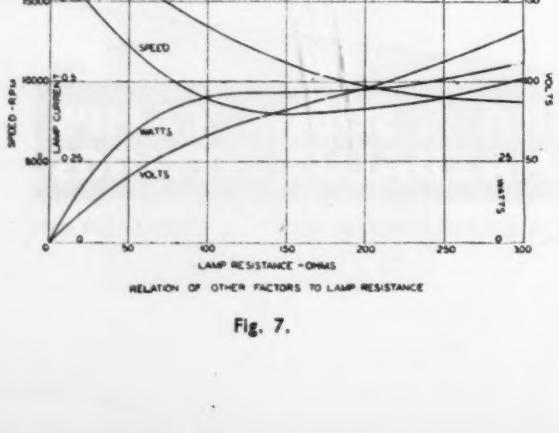


Fig. 7.

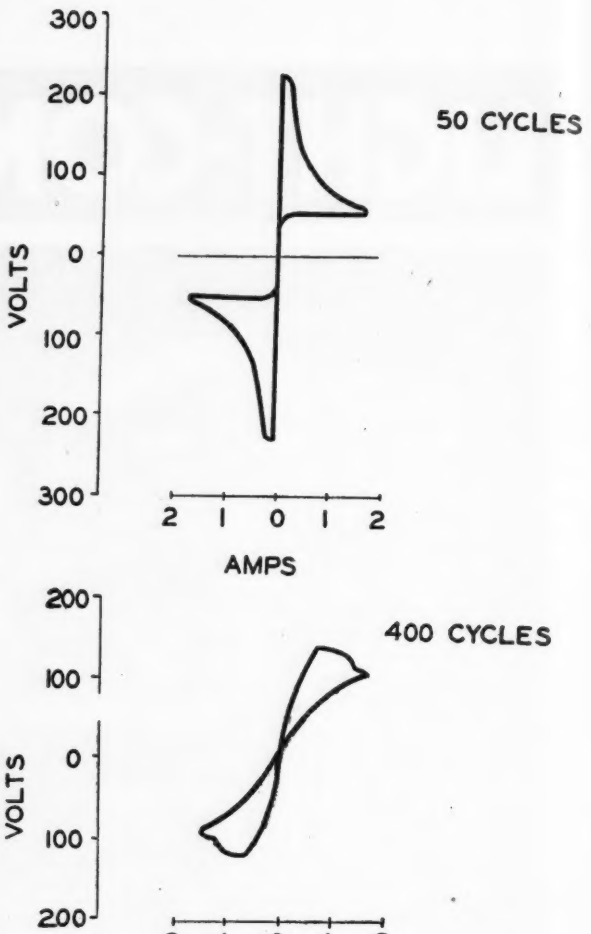


Fig. 8.

amount of light output immediately after striking. Fluctuations in air pressure down to 40 lb. per sq. in. will not affect the output of the lamps owing to the operation of the spring controlled regulating valve. The inertia of the generator will be sufficient to prevent the lamp from being extinguished in the case of very short interruptions of the air supply. A slow drop in the air pressure will not cause the lamp to

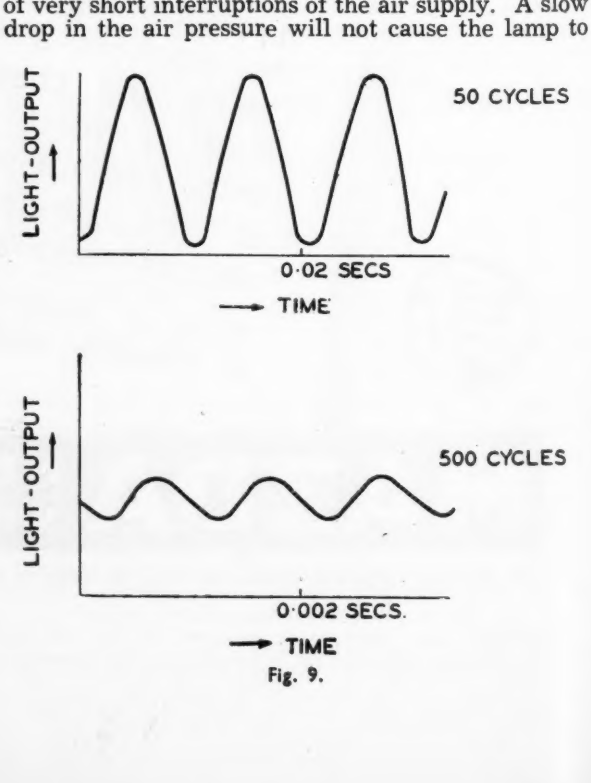


Fig. 9.

extinguish, but if the pressure falls below 40 lb. per sq. in. then the wattage at which the lamp operates will fall also.

The colour of the light yielded by the mercury vapour lamp again, whilst not suitable for some purposes, is of little importance in a coal mine. Indeed, it has been found to be better than that of incandescent filament lamps for discriminating between coal and foreign matter, and is definitely advantageous at the sorting and loading points.

The new lamps have rapidly found favour among colliery owners. In one typical colliery they are in use on the coal face at a seam 7 ft. 6 in. to 8 ft. thick. The units are spaced six to seven yards apart, and are suspended 1 ft. 6 in. to 2 ft. below the roof, 4 ft. 6 in. to 5 ft. from the coal face. In another part in the same colliery the M.L. lamps using incandescent filament lamps are employed. The great improvement in the case of the mercury vapour lamps is very noticeable, and the increase in the general all-round illumination is most marked. The whole width of the seam is illuminated satisfactorily, even at points half way between two lamps, as is shown in Fig. 10. The

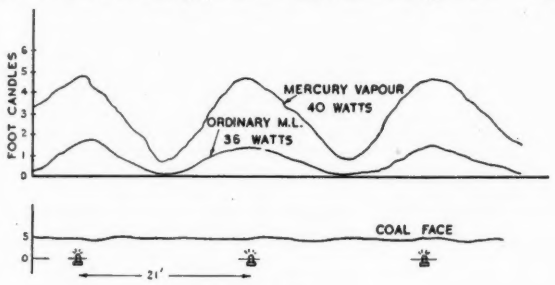


Fig. 10.

illumination on the coal face varies from 0.75 ft.c. to 5.0 ft.c., which is about four times that obtained with the incandescent lamps.

It has been found that in collieries using these new lamps the disease known as nystagmus, formerly prevalent in poorly-lighted mines, has completely ceased, and that accidents and costs of compensation have much diminished. The benefits gained in safety, comfort, and economy are considered to far outweigh the additional cost of the lamps. In mines where both types of lamp are in use the miners themselves are continually pressing their managers to replace the incandescent lamps with mercury lamps as rapidly as possible.

The life of the mercury vapour lamps in coal mines is very long. In a number of cases lives exceeding 3,000 hours have been reported. The long life, combined with the high efficiency of the lamp, has resulted in the mercury vapour lamp proving more economical in use than the older form of M.L. lamp, in spite of the higher initial cost of the unit and of the replacement of bulbs. Thus when all the advantages of the new form of lamp are considered, and when it is shown that in addition to these advantages the lamp gives more light for less cost than the older M.L. lamp, there is no doubt that its use will become widespread throughout the mines of this country. The lamp is also being used in mines on the Continent.

In conclusion, the writer wishes to acknowledge with thanks permission to use information obtained at the Research Laboratories of the British Thomson-Houston Company, Ltd., and of Messrs. Joseph Lucas, Ltd., and to Mr. T. C. Maynard, of Norton and Biddulph Collieries, Ltd., for information regarding underground tests with these lamps. The permission of the Secretary of the South Wales Institute of Engineers for the use of the diagrams illustrating this article is also acknowledged with thanks. It is, of course, needless to say that the author expresses his gratitude for the co-operation of his co-authors in the previous paper, Messrs. E. A. Watson, L. J. Davies, and T. David Jones.

Literature on Lighting

(Abstracts of Recent Articles on Illumination and Photometry in the Technical Press)

(Continued from page 130, August, 1940.)

I.—RADIATION AND GENERAL PHYSICS.

166. Ultra-Violet and Infra-Red Radiations on the Farm.
Anon. Nature, Vol. 145, No. 3,668, p. 257, February 17, 1940.

At a meeting of the American Society of Agricultural Engineers, it was stated that if electric current becomes cheap enough, a wide range of uses is possible for ultra-violet and infra-red radiation on the farm. Some of these uses are summarised. R. G. H.

167. The Measurement of Sight.
L. H. Hardy. Am. Illum. Eng. Soc. Trans., pp. 605-624, 7, July, 1940.

An account of certain aspects of vision from the point of view of the optician is given ,with particular reference to tests for visual acuity. J. S. S.

168. Origin of Visual After-Images.
K. J. W. Craik. Nature, Vol. 145, No. 3,674, p. 512, March 30, 1940.

An experiment is described which indicates that visual after-images are of retinal and not central origin. R. G. H.

II.—PHOTOMETRY.

169. A Device for the Determination of Illumination.
B. F. Greenberg. Am. Illum. Eng. Soc. Trans., pp. 629-635, 7, July, 1940.

A method for the calculation of illumination from sources of irregular shape is described. A series of scales based upon the unit sphere and zonal methods of calculation is used. J. S. S.

170. Colour Vision and Chromaticity Scales.
W. D. Wright. Nature, Vol. 146, No. 3,692, p. 159, August 3, 1940.

A brief summary of recent researches on vision is given, and the C.I.E. method of colour measurement described. The chief disadvantage of the C.I.E. system is that it provides but a poor colour chart. By suitably adjusting the shape and scales of the diagram a fair approximation to a uniform chromaticity scale can be obtained, but the approximation may not be of practical value. R. G. H.

IV.—LIGHTING EQUIPMENT.

171. Progress in Projection Lighting.
W. C. Kalb. J. Soc. Mot. Pict. Eng., Vol. 35, p. 17, July, 1940.

Surveys the development of the carbon arc from its origin to the present day, and illustrates in particular the advantages of the high-intensity arc. R. G. H.

172. Report of the Studio Lighting Committee (Society of Motion Picture Engineers).
J. Soc. Mot. Pict. Eng., Vol. 35, p. 86, July, 1940.

A brief survey is given of new studio lighting equipment, including carbon-arc, incandescent, and, more recently, daylight fluorescent lamps. R. G. H.

173. Progress in Motion Picture Industry.
Anon. J. Soc. Mot. Pict. Eng., Vol. 34, No. 5, pp. 455-484, May, 1940.

Recent improvements in lighting equipment are surveyed. In particular notes are given on the following:—

(1) Black-capped projection lamps for sub-standard projectors to simplify lowering and to provide better ventilation;

(2) Three water-cooled S.H.P.M.V. lamps in a single reflector for television studio lighting, each lamp on a separate phase; and

(3) Reflector incandescent lamps of 300-watt rating for television studios. R. G. H.

174. Progress in the Motion Picture Industry, (4) Studio Lighting.
Anon. J. Soc. Mot. Pict. Eng., Vol. 34, No. 5, p. 460, May, 1940.

Summarises recent improvements in studio lighting equipment for motion picture studios. New fluorescent lamp, smaller spotlights made possible by the use of faster film, and new photo-flash lamps are described. R. G. H.

175. New Lenses for Projecting Motion Pictures.
W. B. Rayton. J. Soc. Mot. Pict. Eng., Vol. 35, p. 89, July, 1940.

Describes two new wide aperture lenses made in high-transparency glass, and surface treated to eliminate surface reflections. To prevent damage by cleaning, the lens components are sealed air-tight. R. G. H.

176. Speed up Your Lens System.
W. C. Miller. J. Soc. Mot. Pict. Eng., Vol. 35, p. 3, July, 1940.

The treatment of lens surfaces with a very fine layer of transparent film of low refractive index can eliminate up to 85 per cent. of the surface reflection losses. A complicated anastigmat lens can be speeded up in this way by as much as one stop (i.e., transmission doubled). In addition, flares and ghost images are eliminated. (Some of the claims for the process, especially that of the increased lens transmission, were considered rather excessive by speakers at the discussion, but the value of the process was not questioned.) R. G. H.

177. Change of Ultra-Violet Transparency of Glass with Temperature.
W. J. Arrol. Nature, Vol. 145, No. 3,683, p. 861, June 1, 1940.

A strictly linear relation holds between the absorption coefficient and the temperature of a wide range of glasses over the range 10°-50° C. to radiation of 3,300-3,100 A. R. G. H.

V.—APPLICATIONS OF LIGHT.

178. Light and Architecture.
Anon. Am. Illum. Eng. Soc. Trans., pp. 585-590, 7, July, 1940.

Some representative architectural lighting schemes are described with photographs. J. S. S.

179. Shop Fronts as Visualised by To-morrow's Architects.
C. T. Masterton. Magazine of Light, IX., No. 4, pp. 12-13, May, 1940; Magazine of Light, IX., No. 2, pp. 18-19, February, 1940.

Details with photographs, are given of designs submitted to the American I.E.S., co-relating lighting and architectural requirements for a store. C. A. M.

180. Artificial Lighting in Industry.
G. V. Downer. Elect., 125, p. 31, July 19, 1940.

The author discusses the present needs of artificial lighting in industry. He stresses the importance of the characteristics of Northern daylight, and recommends this as an objective to which approximation may be made with artificial light sources. Under such conditions good visibility can be obtained with considerably less intensity than at present thought necessary. C. A. M.

181. Industrial Lighting is Ready for an Upswing.
G. J. Taylor. Magazine of Light, IX., No. 4, pp. 31-33, May, 1940.

A number of recent industrial installations are described with photographs. In all cases the spacing of the fittings is less than the height to the working plane, and in consequence high illumination values are obtained. In one instance a general illumination value of 40 ft.c. is supplemented by local bench lighting from tubular fluorescent lamps to a total value of 250 ft.c. C. A. M.

182. Light Must Help to Go To It.
Anon. Elect., 125, p. 3, July 5, 1940.

Stress is laid on the need for better lighting in the present munitions drive in order to increase production and reduce spoilage over a twenty-four-hour day. C. A. M.

183. Choosing the Right Lamp for the Job.
H. F. Barnes. Magazine of Light, IX., No. 4, pp. 16-17, May, 1940.

Tabular data are given for various levels of illumination on the application of the various types of light sources to the particular requirements of commercial, general, store, and industrial lighting. C. A. M.

184. Drying Lamps Speed up Various Industrial Processes.
Anon. Magazine of Light, IX., No. 4, pp. 33-34, May, 1940.
Some details are given of paint drying equipment used in various industrial processes. Assemblies of two or three hundred lamps in reflectors are used at a time. C. A. M.

185. Mass Colour Lighting.
Anon. El. Times, 98, p. 23, July 11, 1940.
The New Zealand Centennial Exhibition had many examples of coloured lighting. Some details of equipment used are given. W. R. S.

186. Influence of Fluorescent Lighting on the Colours of Decorations and Furnishings.
A. H. Taylor. Am. Illum. Eng. Soc. Trans., pp. 625-628, July 7, 1940.
An account is given of comparisons between (1) daylight and (2) light from tungsten filament lamps and fluorescent lamps approximating to these light sources as regards their effect on a range of standard colours. It is claimed that the effect of the fluorescent lamps is generally small and unobjectionable. J. S. S.

187. Application of Fluorescent Lamps to Industrial Lighting.
Anon. Magazine of Light, IX., No. 4, pp. 36-38. May, 1940.
Numerous instances with photographs, are given of the application of tubular fluorescent lamps to such industrial requirements as silk, hosiery, and cloth, tinplate, and fruit inspection, and weaving with a Jacquard loom. C. A. M.

188. Institution Lighting.
Anon. Elec., 125, p. 22, July 12, 1940.
A solution of the problem of applying modern lighting practice to a Renaissance-style building without spoiling the architectural features is given in the new lighting equipment at the Institution of Civil Engineers. C. A. M.

189. Heating Hotbeds with Radiant Energy from Incandescent Lamps.
R. L. Zahour. Am. Illum. Eng. Soc. Trans., pp. 591-604, July 7, 1940.
Experiments on seed germination and vegetable growth in beds heated by incandescent lamps suspended above. It is claimed that this method is cheaper than heating by buried cables, and that the infra-red radiation present stimulates germination. J. S. S.

War-time Electric Street Lighting

Carlisle Corporation.—A number of main roads are being lighted in accordance with the War-time Street Lighting Specification.

Chatterton U.D.C.—The council has decided to install war-time street lighting.

Lancaster City.—The corporation has installed war-time street lighting fittings for all main roads.

Leicester.—The city council has made arrangements for lighting many side roads in addition to the streets on which war-time street lighting has already been installed.

Oldham.—Steady progress is being made with the installation of lighting in accordance with B.S./A.R.P. 37.

Rushden.—The urban district council has decided on the adoption of war-time street lighting in accordance with B.S./A.R.P. 37.

St. Marylebone.—Nearly all the streets in the borough are now lighted, and it is expected the remainder will be completed very shortly.

Shipley U.D.C.—War-time street lighting is being installed in a number of streets.

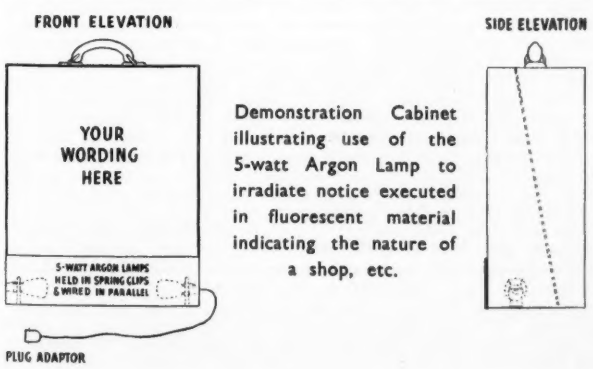
Trowbridge.—Forty-nine lamps in the main road and at important junctions are to be adapted for war-time street lighting at a cost of £33 17s. 6d. Under the council's war-time street lighting contract arrangements the annual cost, including the forty-nine lamps to be lighted, will amount to £500.

Warwick.—Following the borough surveyor's report to the council as to the cost of fitting and lighting a number of street lamps normally extinguished at 11 p.m., the council has instructed him to proceed with the work.

Paisley.—The Lighting and Watching Committee has authorised the installation of 1,887 war-time street lighting fittings at a cost of £1,500, plus a maintenance charge of £1 per lamp per annum for side street lighting.

The 5-Watt Argon Lamp

The 5-watt Argon lamp, illustrated in a recent leaflet issued by Philips Lamps, Ltd., promises to be a very useful source of ultra-violet radiation, especially in cases when low consumption is desirable and the source can be placed within a short distance (say, up to 12 in.) from the material to be excited. The lamp can be plugged direct on the supply without condensers or transformers being necessary, and is of very compact dimensions (85 mm. long and 45 mm. dia.). Having no filament, it is practically immune from effects of vibration, and it produces no appreciable heat. Among its possible applications are for bollards (equipped with a message executed in fluorescent paint), for directional signs similarly treated, and for general signs of low brightness such as those used to indicate that a shop is open and the nature of its business. The accompanying sketch shows a convenient form of demonstration cabinet, by the aid of which the properties of the lamp can be readily demonstrated.



Demonstration Cabinet illustrating use of the 5-watt Argon Lamp to irradiate notice executed in fluorescent material indicating the nature of a shop, etc.

War-Time Street Lighting by Gas

Leeds Corporation Gas Committee are proceeding with the installation of war-time street lighting units in the main suburban streets of the city after inspection of trial installations in two roads.

The Sheffield Safety First Council has passed a resolution of thanks to the Corporation for the modified street lighting installed in the town. Work is still proceeding to bring Sheffield's lighting into line with war-time conditions, and by the winter 24,000 gas and electric lamps will be fitted for "starlight" lighting.

Leamington Corporation are continuing their tests of low intensity lighting and have placed an order for a further 100 gas units to be fixed in selected main and side streets.

From the second week in September the streets of Hinckley, Earl Shilton, Barwell, and Burbage will be illuminated with 800 gas starlights. Several main streets in Hinckley were lighted in this way last winter, the experiment proving so successful that the Council decided upon a scheme for the whole of the urban area.

In what follows, an impressive list is given of some of the districts normally lighted partially or wholly by gas, in which the gas undertakings or Councils have already ordered from 50 up to 6,000 or more of the new gas lighting fittings:—

Between 500 *and* 6,000 *fittings ordered*:—

Blackpool, Bristol, Burnley, Chigwell, City of London, Coatbridge, Darlington, Dewsbury, Finsbury, Glasgow, Hinckley, Lancaster, Leicester, Manchester, Rotherham, Sheffield, Shrewsbury, Swadlincote, St. Helens, Wallasey, Westminster, Widnes.

Between 100 *and* 499 *fittings ordered*:—

Bangor, Bath, Belfast, Blackburn, Bolton, Birkenhead, Bradford, Bury, Carlisle, Castleford, Chesterfield, Colne, Crewkerne, Darwen, Dudley, Glastonbury, Grantham, Halifax, Hamilton, Keighley, Kendal, Kilmarnock, Lanark, Leigh (Lancs), Lytham St. Annes, Middleton, Newry, Northampton, Northwich, Oldbury, Oldham, Oswaldtwistle, Preston, Rochdale, Rushden, Shepshed, Stourbridge, Stratford-on-Avon, Stretford, Tyldesley, Wellingborough.

Between 50 *and* 99 *fittings ordered*:—

Barrow-in-Furness, Bingley, Birmingham, Coventry, Doncaster, Dumbarton, Eccles, Kirkintilloch, Farnham, Glossop, Huddersfield, Loughborough, Malton, Neath, Nelson, Nottingham, Pontefract, Rawmarsh, Rochdale, Salford, Shaftesbury, Shirebrook, Sidmouth, Warwick, Wedmore, Wombwell, Wymondham.

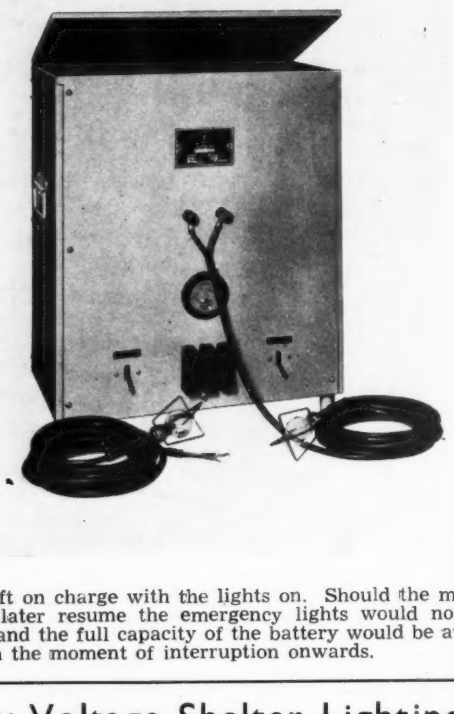
Reviews of Books

Photo-Electric and Selenium Cells. By T. J. Fielding. (Chapman and Hall, Ltd., London, 1940, pp. 164, viii, Fig. 82. 7s. 6d. net.)

In the preface the author remarks that whilst much has been published on photo-electricity there is little information available for those whose knowledge of this subject is limited. He therefore aims at presenting a general survey readily followed by the average practical man or student. The initial chapter is devoted to an explanation of the photo-electric effect, after which several types of photo-electric cells (photronic or rectifier) and selenium cells are discussed and their relative advantages and limitations explained. Chapters are devoted to the making of selenium cells apparatus for amplification and time delay circuits. Photo-electric response to radiation from different parts of the spectrum is illustrated and several commercial types of photo-cells are briefly described. The latter part of the book, which deals mainly with applications, will no doubt prove of general interest. The author sketches some simple home experiments (shadowgraphs, playing gramophone records by light, burglar alarms, and controlling model railways) and briefly reviews the use of the photo-cell in television and talking pictures. Numerous industrial applications such as safety devices, precision gauging, the control of lifts and other mechanism, and of temperature and smoke density, are described. Final chapters deal with the uses of such cells in advertising (more particularly the control of luminous signs) and miscellaneous applications such as the talking book, the post office speaking clock, etc. An application of major importance to our readers—the photo-electric photometer—is only briefly mentioned. A final section touches on the possibility of cells sensitive to infra red radiation in combating the dangers of fog.

Emergency Lighting

A convenient device illustrated below is the Ediswan Tungare Ensur-a-lite, which consists essentially of a battery (6 or 12 v.) and charger enclosed in a metal case. This is suitable for emergency lighting in shelters, hospitals, cinemas, and large private houses. In emergency the battery

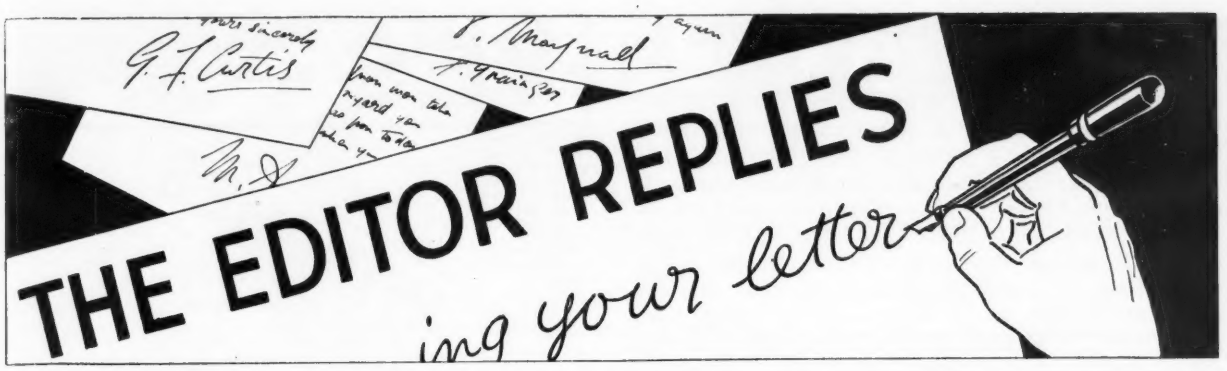


can be left on charge with the lights on. Should the mains fail and later resume the emergency lights would not be affected, and the full capacity of the battery would be available from the moment of interruption onwards.

Low Voltage Shelter Lighting

The convenience and safety of low voltage lighting for shelters is widely recognised, and the device, illustrated below, offered by the British Electric Transformer Company, Ltd., in connection with Crompton Parkinson, Ltd., is of interest in this connection. It consists of a double air-cooled

transformer, with switch and fuses, enclosed in an iron case. Transformers of 50, 75, 100, 150, or 250 VA can be accommodated. The voltage should in general be one of those recommended in the B.S.I. specification (12, 25, 32, or 50 v.).



I have been asked by several readers to revive this column (at one time a very popular feature), which it is thought should prove of added interest in war time as an outlet for exchange of information and experience in the solution of knotty problems. I do so gladly, subject to two provisions—(1) readers must do their part by sending in letters containing material for discussion (Mr. Long?), and (2) this column is to be regarded in the same broad sense as before, as being free for the ventilation of all topics of interest, whether arising from letters, conversations, or quotations from the Press. In other words, it is to afford an opportunity for inoffensive and, if possible, informative gossip—subject, of course, to the limitations imposed by official regulations and shortage of paper.

I may commence by referring to the question of **Jobs,** a problem of perennial interest to readers. It was formerly my experience that applications for jobs invariably exceeded offers. But of late the tendency has been rather the other way. Ultimately there may well be a dearth of men competent to handle industrial lighting installations—work on which is in full swing at the present moment. Evidently the services of this relatively small band of experts should be preserved, and it is understood that recommendations to the authorities on this point have already been made. (Readers, in the meantime, are reminded of the recent Order by which all professional engineers and engineering scientists having specified qualifications must apply for registration.)

Another familiar topic is **Inventions.** Of these there was a furious spate during the early months of war "when every day brought forth a noble chance" and every chance an enthusiastic visitor. More recently the pressure of those with bright ideas for relieving the black-out seems to have subsided. Opportunities for inventions in this field are naturally limited by the Lighting Restrictions Order and the official adoption of specifications for war time street lighting, etc. From the administrative standpoint such uniformity is inevitable. One finds however that the same ideas constantly recur amongst inventors—the restriction of the beam from a lamp enclosed in a cylindrical case with concentric screens at intervals is a case in point. More unusual was the illuminated white stick for use in the black-out, in one special case terminating in a base mounted on rollers, propelled in front of the user, which rang a bell and burst into cheerful luminous splendour whenever an obstacle was encountered. There is, however, still room for enterprise within the limits of regulations, and in some instances—in connection with signs and shop window lighting, for example—a considerable amount of ingenuity has been shown.

My attention has been drawn to the correspondence in the "Electric Review" in regard to the use of the term **"Intensity"** as applied to illumination. I confess that I am at one with Mr. Howard Long on this matter. "Intensity" is associated with the definition of candlepower and its use in connection with illumination is incorrect—apart from the objectionable nature of strange hybrid compound words such as "illumination intensity." If it is desired to refer to specific figures "values of illumination" is surely very much better.

I usually receive at intervals enquiries in regard to **the transmission of lights** of different colours. Since the outbreak of war interest in the matter has been accentuated by A.R.P. conditions. There can be no harm in affirming that there is no great advantage in using blue light from this standpoint, even though it be admitted that in general light from the blue end of the spectrum penetrates the atmosphere less easily and is diffused thereby. A recent rather mystic communication refers to "penetration through earth, sea and air." Although I have no full data available I believe that the conclusion in regard to water is similar—more especially when the water holds small particles in suspension. In regard to earth I can quote no evidence unless it be a novel by Frank Stockton ("The Great Stone of Sardis?") in which the inventor devised a ray capable of penetrating the earth for great distances and revealing what existed at its extremity—a device of great value to water diviners and mining prospectors, but not yet recognised in the exact sciences.

A correspondent has drawn my remarks to several suggestions in the daily Press, for example, the lighting of the interior of **telephone kiosks** and the uprooting of lampposts for the salvage of the metal they contained. It is possible, as the G.P.O. seems disposed to infer, that absence of light in telephone kiosks is no great drawback during the long days of summer. But in winter matters become more serious and the use of a torch is awkward, except for the three-handed. The provision of an illumination sufficient to enable users to dial comfortably, and yet so arranged that no appreciable light strays outside the kiosk, does not seem an insuperable problem. We commend it to the I.E.S.

In regard to the **lamp posts** I expect few public lighting engineers are quite so pessimistic in regard to the duration of the war as to view the scrapping of all but a few posts with equanimity. On the other hand, advocates of closer spacing might view this procedure more favourably, regarding it as preparation for a blessed future when they could, like Omar, "remould things nearer to the heart's desire."

My attention has been drawn to a new difficulty in railway travel, likely to prove highly inconvenient during the winter—the obliteration of **station nameplates.** In the early days of the black-out the fact that nameplates were, in general, invisible at night proved troublesome, and weak, screened lighting was fairly generally introduced. Now it is the objects illuminated that have vanished! Even in the daytime travellers may well feel uncertain when they have arrived at their destination, but during the black evenings before us confusion will become worse confounded. This is not a problem only for those making special journeys an unfamiliar routes. It concerns equally those who have to travel home from their work, night after night—and who may be in danger of alighting at the wrong station, or even where there is no station at all. It should not be beyond the wit of the railway companies to see that all stations are furnished with carefully placed illuminated nameplates, sufficiently conspicuous to the traveller and yet invisible from above. I also recall a mechanical device with which railway carriages were at one time equipped, and which, operated from the guard's van, released a flap showing the name of each station shortly before arrival. If the present conditions are to last for a considerable time—as seems not unlikely—the revival of this device seems worth considering.

Accidents in the Black-out

Statistics have now been issued for London road casualties during the first half of the present year. Casualties totalled 15,623, as compared with 26,630 in the corresponding period of 1939—a reduction of over 40 per cent. Casualties at night amongst all classes of road users totalled 174 killed and 4,328 injured, as compared with 200 killed and 10,921 injured during hours of daylight. The night/day ratio would thus work out intermediate between summer and winter values, as one might expect. The general diminution, as compared with 1939, might also be anticipated, in view of the very much smaller volume of traffic on the roads. Examination of details supports the views expressed in our last issue (August, 1940, p. 124). Thus the total number of fatal accidents was 374, against 459 for 1939, again a decrease. Of this total, however, the large proportion of 260 deaths related to pedestrians. Of these, only seventy-eight occurred during the second quarter of the year and 182 during the first dark winter quarter, and of this number 132 occurred during the hours of darkness, an increase of nearly 47 per cent. as compared with 1939. The night/day ratio for the winter quarter would thus be 132/50, or approximately 2.6:1, a high figure bearing in mind how greatly the number of pedestrians on the roads by night has diminished.

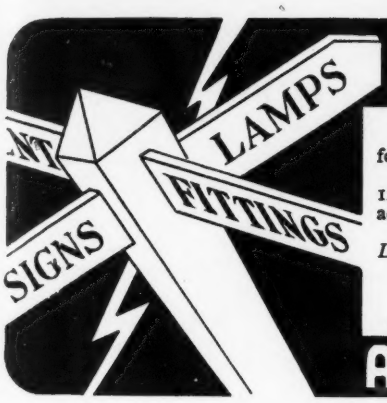
Oh, Say, Can You See?

In a report under the above title* Mr. E. R. Sherrbaum, Electrical Engineer to the New Jersey State Highway Department, summarises the results of an inquiry designed to establish whether or not expenditure of State funds for safety lighting on highways at places other than intersections is economically justified. Experiments have been conducted on three selected stretches of roadway during the past three years. In sixteen counties where modern State highway safety installations were made the death toll was 155 fewer than in the previous year. During 1938, as compared with 1937, there were decreases of 45 per cent. in deaths, 20 per cent. in injuries, and 19 per cent. in injuries occurring by night. On the other hand, on these same sections, and during the same period, the number of accidents and injuries during the daytime increased.

* Trans. Illum. Eng. Soc., U.S.A., July, 1940, p. 574.

Improved Lighting for Buses

It has recently been announced that a new device, shedding diffused light on the boarding platform and the adjacent pavement, has been approved by the Ministries of Home Security and Transport, and is being fitted to buses, trams, and trolley buses in London. This is likely to prove a boon to passengers during the black-out. It is to be hoped that the summer period is also being utilised to make other improvements, e.g., to develop the headlights used by buses and tramcars within the permissible limits. Arrangements such as those described for tramcars in BS/ARP 41 should not only aid drivers by giving them improved illumination ahead, but should also serve a subsidiary useful purpose in shedding a little light sideways below the horizontal. This is of appreciable help to passengers in enabling them to recognise objects and ascertain when they have arrived at their destination. As regards the interior lighting of buses, the modified regulations permit conditions which at least represent a vast improvement on those commonly used in the early days of the black-out. There remains one other problem, the illumination of destination plates so as to be recognisable without being unduly bright. During the past winter arrangements were often very imperfect, the brightness being so uneven as to make letters indistinguishable at a little distance. The blue tinted light, resulting from the use of lacquer to diminish the power of the lamps, was the worst possible choice from the standpoint of sharpness of definition. Matters have been somewhat improved since, but the problem is difficult to solve by the adjustment of existing apparatus, and new methods might prove advantageous in the long run.



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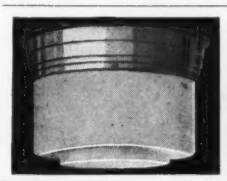

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N.B.—The numbers are those attached to individual entries in the Directory (See pp. 155—156)